

## Executive Summary – Hopewell Preliminary Data Report

**Introduction** - In 2006, the Virginia Department of Environmental Quality (DEQ) applied for a special grant to establish and operate a comprehensive Air Toxics monitoring project in the Hopewell area. The Office of Air Quality Planning and Standards (OAQPS) of US Environmental Protection Agency (EPA) awarded DEQ Office of Air Quality Monitoring (AQM) funding for this short term study. The project enabled DEQ to perform ambient air sampling in the Hopewell area for a limited number of air pollutants classified as toxic air pollutants in the Virginia Regulations for the Control and Abatement of Air Pollution. The collected data and subsequent data review have been provided to the DEQ Risk Assessment office to provide information for the risk analyses to be performed as a result of this study.

The formal sample gathering phase of the Hopewell Toxics study ended on September 30, 2008. This Executive Summary is intended to highlight the findings of the study relative to both existing regulatory requirements and toxics analytical results in other parts of Virginia. For the purposes of this Preliminary Data Report the Office of Air Quality Monitoring (AQM) made the simplifying assumption that the data fit a normal distribution pattern. This enabled the report to contain commonly understood statistical data such as standard deviations to make the data review more understandable. It is important to understand that this simplifying assumption does not constrain the approach to the risk analysis currently being performed in DEQ's Office of Risk Assessment.

One highly important caveat must be applied to any analysis of the results of the Hopewell toxics study. The study was designed to determine if overall concentrations of measured toxics compounds warranted focusing additional DEQ Air Division resources in the Hopewell area to further characterize specific state air toxics compounds. Results of the chemical analysis in most cases showed a high degree of variability; a fact that limits DEQ's ability to use these results to specify ambient air concentrations with a reasonable degree of confidence.

**Conclusions** - Accepting the limitations and assumptions above, the information below characterizes the Hopewell study:

1. The Hopewell toxics study sampled for 53 Volatile Organic Compounds (VOC), 5 VOC/Carbonyl compounds, 7 metals, and Hexavalent Chromium at 3 sites; Woodson Middle School (upwind site), Spruance Street (central site) and VCU Rice Center (downwind site). Of this list, 34 of the VOC compounds, 3 of the Carbonyl compounds, all of the metals and Hexavalent Chromium are listed as state air toxic compounds i. e. they have a Significant Ambient Air Concentration (SAAC) value (9 VAC 5-60-230, 9 VAC 5-60-330). The compounds analyzed were the same as those used in the Urban Air Toxics program. The pollutants were pre-approved by EPA.
2. Looking at a worst case scenario of the data – calculating averages ignoring the non-detectable data – 33 VOC's, 2 Carbonyl compounds, 7 metals and Hexavalent Chromium did not exceed the State's short term or long term SAAC. This translates to 96% of the sampled state air toxics compounds in the study did not meet or exceed the SAAC value under a worst case calculation (Exhibits 1, 2, 3).
3. Two compounds under the worst case calculations required additional evaluation; Acrolein and Formaldehyde. Neither compound exceeded the short term (hourly) calculated

SAAC. Results of the worst case calculations for the long term (annual) averages require further evaluation to interpret the analytical results for these compounds (Exhibits 1, 2, 3).

4. Evaluation of the analytical results for Formaldehyde showed that recalculation of the long term averages using the non-detectable data would have little effect on the long-term annual averages. Evaluation of the results for Acrolein indicated that recalculation of the long term averages was warranted.

5. Recalculation of the long term Acrolein averages using 3 separate methods for incorporating the non-detectable data indicates that the calculated annual average for Acrolein in 2008 is in the range of the calculated SAAC for this compound at the upwind and central monitoring sites (Exhibit 4). Care must be taken in interpreting these results for the following reasons:

1. The method for analyzing for Acrolein changed during 2007 based on information from EPA. We have received data for the Spruance site and the Woodson site through the end of 2008. We used the 1/1/2008 through 9/30/2008 data for the Rice Center.

2. The standard deviation for the Acrolein data represents a wide range of variability in the data set used to calculate the long term average.

6. Evaluation of toxics monitoring sites around the Commonwealth of Virginia and across the United States indicates that there is a likely regional character to the presence of both Acrolein and Formaldehyde. Exhibit 5 presents the possible sources of Formaldehyde and Acrolein identified in the 1999 National Air Toxics Trend Analysis. Exhibit 6 compares Hopewell with other toxics sites across the country.

**Further Study** - AQM has already taken several key steps for further study relative to air toxics in the Hopewell area. AQM has upgraded the Woodson site to an urban air toxics site and this site is now included with the data reported to EPA as part of the Urban Air Toxics program. AQM is also continuing the analysis of VOC's and has begun sampling for Poly Aromatic Hydrocarbons (PAH) at the Spruance site. AQM has installed a Reduced Sulfur compounds monitor at the Spruance site as well. Additional steps beyond these will be discussed with the stakeholder's group and further steps for dissemination of this information will be developed through a consensus approach with the stakeholder's group.

# Exhibit 1. Analytical results for Hopewell study – Woodson Site

## Hopewell Air Monitoring Project \_ C.G. Woodson site (11/19/2006 - 9/27/2008)

Volatile Organic Compounds (Method TO-15) - Unit of Concentration: ug/m3

(Compounds with no detectable results are not included)

#	CASS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	115-07-1	43205	Propylene	2		1.668		1.307	0.511
2	75-71-8	43823	Freon-12	106		3.606		2.525	0.525
3	74-87-3	43801	Methyl Chloride	108	5175	1.753	206	1.146	0.281
8	75-00-3	43812	Ethyl Chloride	1	132000	0.474	5280	0.474	
9	107-02-8	43505	Acrolein	29	17.25	1.557	0.46	0.721	0.360
10	75-69-4	43811	Freon-11	104		2.245		1.528	0.296
12	75-09-2	43802	Methylene Chloride	68	8700	3.781	348	0.565	0.490
13	76-13-1	43207	Freon-113	79		2.067		0.857	0.257
18	100-54-3	43231	Hexane	22	8800	1.584	352	0.640	0.354
24	71-43-2	45201	Benzene	78	1600	2.266	64	0.667	0.364
25	56-23-5	43804	Carbon Tetrachloride	75	1550	4.022	62	0.704	0.401
26	110-87-7	43248	Cyclohexane	2		0.653		0.602	0.073
31	142-82-5	43232	Heptane	16		1.638		0.604	0.300
35	108-88-3	45202	Toluene	98	14125	6.888	754	1.244	0.977
40	100-41-4	45203	Ethylbenzene	16	13575	0.954	868	0.550	0.192
41	108-38-3	45109	m&p-Xylene	51	16275	2.863	868	0.835	0.618
42	75-25-2	43806	Bromoform	1	260	1.755	10	1.755	0.000
43	100-42-5	45220	Styrene	3	10650	0.553	426	0.454	0.107
45	95-47-6	45204	o-Xylene	18	16275	1.171	868	0.566	0.233
46	622-96-8	45213	1-Ethyl-4-methylbenzene	4		1.129		0.614	0.346
47	108-67-8	45207	1,3,5-Trimethylbenzene	4		1.080		0.737	0.343
48	95-63-6	45208	1,2,4-Trimethylbenzene	33		5.991		1.003	1.021
49	541-73-1	45806	1,3-Dichlorobenzene	4		0.601		0.540	0.069
50	106-46-7	45807	1,4-Dichlorobenzene	8	16525	2.042	902	1.066	0.548

\* Maximum number of samples is 114.

**Hopewell Air Monitoring Project \_ C.G. Woodson site (11/19/2006 - 9/27/2008)**

Carbonyl Compounds (Method TO-11) - Unit of Concentration: ug/m3

#	CAS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	75070		Acetaldehyde	109	6750	4.36	360	1.87	0.71
2	67641		Acetone	107		13.40		5.52	2.52
3	50000		Formaldehyde	111	62.5	8.35	2.4	2.96	1.55
4	79933		Methyl Ethyl Ketone	91		1.21		0.69	0.19
5	123386		Propionaldehyde	45	NA	2.74	NA	0.88	0.55

\* Maximum number of samples is 114

**Hopewell Air Monitoring Project \_ C.G. Woodson site (11/19/2006 - 9/27/2008)**

Metals Scan (PM10 ICPMS Method) - Unit of Concentration: ug/m3

#	CAS #	AQS #	Pollutants	N	SAAC, hourly µg/m3	Maximum, µg/m3	SAAC, annual µg/m3	Average, µg/m3	STD, µg/m3
1	7440417		Beryllium	93	0.1	2.874E-04	0.004	3.923E-05	1.145E-04
2	7440473		Chromium	93	2.5	1.000E-02	0.1	3.161E-03	1.078E-03
3	7439965		Manganese	93	250	1.021E-02	10	3.451E-03	1.740E-03
4	7440020		Nickel	93	50	2.047E-02	2	1.687E-03	2.249E-03
5	7440382		Arsenic	93	10	4.122E-03	0.4	1.032E-03	6.331E-04
6	7440439		Cadmium	93	2.5	7.005E-04	0.1	2.082E-04	1.360E-04
7	7439921		Lead	93	7.5	8.473E-03	0.3	3.186E-03	1.530E-03

\*Maximum number of samples is 114

**Hopewell Air Monitoring Project \_ C.G. Woodson site (11/19/2006 - 9/27/2008)**

Hexavalent Chrome (Low Flow PM10) - Unit of Concentration: ug/m3

#	CAS #	AQS #	Pollutants	N	SAAC, hourly µg/m3	Maximum, µg/m3	SAAC, annual µg/m3	Average, µg/m3	STD, µg/m3
1	7440473		Hexavalent Chrome Non-corrected	98	2.5	1.222E-03	0.1	1.765E-04	1.561E-04
2	7440473		Hexavalent Chrome Corrected	98	2.5	1.129E-03	0.1	4.713E-05	1.48E-04

## Exhibit 2. Analytical results for Hopewell study – Spruance Site

### Hopewell Air Monitoring Project \_ Spruance site (11/1/2006 - 9/27/2008)

Volatile Organic Compounds (Method TO-15) - Unit of Concentration: ug/m3

(Compounds with no detectable results are not included)

#	CAS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	115-07-1	43205	Propylene	2		1.358		1.135	0.316
2	75-71-8	43823	Freon-12	113		3.507		2.484	0.514
3	74-87-3	43801	Methyl Chloride	115	5175	1.650	206	1.160	0.263
8	75-00-3	43812	Ethyl Chloride	1	132000	0.448	5280	0.448	
9	107-02-8	43505	Acrolein	32	17.25	2.015	0.46	0.653	0.368
10	75-69-4	43811	Freon-11	109		2.413		1.520	0.260
12	75-09-2	43802	Methylene Chloride	63	8700	1.665	348	0.495	0.251
13	76-13-1	43207	Freon-113	87		2.832		0.911	0.381
18	100-54-3	43231	Hexane	29		4.119		0.832	0.709
20	141-78-6	43209	Ethyl Acetate	1		0.612		0.612	
24	71-43-2	45201	Benzene	90	1600	1.021	64	0.541	0.207
25	56-23-5	43804	Carbon Tetrachloride	83	1550	4.336	62	0.712	0.452
29	79-01-6	43824	Trichloroethylene	1	26750	1.020	538	1.020	
31	142-82-5	43232	Heptane	13		1.678		0.699	0.394
34	79-00-5	43820	1,1,2-Trichloroethane	1	925	0.818	NA	0.818	
35	108-88-3	45202	Toluene	109	14125	3.350	754	0.985	0.642
38	127-18-4	43817	Tetrachloroethene	6	33925	4.539	678	1.739	1.495
40	100-41-4	45203	Ethylbenzene	13	13575	0.737	868	0.477	0.124
41	108-38-3	45109	m&p-Xylene	49	16275	2.603	868	0.747	0.421
45	95-47-6	45204	o-Xylene	16	16275	0.737	868	0.493	0.132
46	622-96-8	45213	1-Ethyl-4-methylbenzene	2		0.835		0.663	0.243
48	95-63-6	45208	1,2,4-Trimethylbenzene	28		1.375		0.786	0.309
49	541-73-1	45806	1,3-Dichlorobenzene	1		1.081		1.081	
50	106-46-7	45807	1,4-Dichlorobenzene	13	16525	2.402	902	1.007	0.563
51	95-50-1	45805	1,2-Dichlorobenzene	1		0.661		0.661	
52	120-82-1	45810	1,2,4-Trichlorobenzene	1	925	3.855	NA	3.855	
53	87-68-3	43844	Hexachloro-1,3-butadiene	1	11	1.491	0.42	1.491	

\*Maximum number of samples is 115

**Hopewell Air Monitoring Project \_ Spruance site (11/1/2006 - 9/27/2008)**

Carbonyl Compounds (Method TO-11) - Unit of Concentration: ug/m3

#	CASS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	75070		Acetaldehyde	109	6750	5.28	360	1.96	0.80
2	67641		Acetone	109		11.22		1.96	2.41
3	50000		Formaldehyde	110	62.5	8.63	2.4	3.22	1.79
4	79933		Methyl Ethyl Ketone	89		74.45		1.76	7.81
5	123386		Propionaldehyde	47	NA	2.81	NA	1.06	0.69

\*Maximum number of samples is 115

**Hopewell Air Monitoring Project \_ Spruance site (11/1/2006 - 9/27/2008)**

Metals Scan (PM10 ICPMS Method) - Unit of Concentration: ug/m3

#	CASS #	AQS #	Pollutants	N	SAAC, hourly µg/m3	Maximum, µg/m3	SAAC, annual µg/m3	Average, µg/m3	STD, µg/m3
1	7440417		Beryllium	103	0.1	2.842E-04	0.004	5.677E-05	1.170E-04
2	7440473		Chromium	103	2.5	5.429E-03	0.1	3.043E-03	8.455E-04
3	7439965		Manganese	103	250	1.116E-02	10	3.635E-03	2.185E-03
4	7440020		Nickel	103	50	4.466E-03	2	1.415E-03	8.059E-04
5	7440382		Arsenic	103	10	2.657E-03	0.4	1.028E-03	5.109E-04
6	7440439		Cadmium	103	2.5	9.724E-04	0.1	1.506E-04	1.537E-04
7	7439921		Lead	103	7.5	7.273E-03	0.3	3.007E-03	1.407E-03

\*Maximum number of samples is 115

**Hopewell Air Monitoring Project \_ Spruance site (11/1/2006 - 9/27/2008)**

Hexavalent Chrome ( Low Flow PM10) - Unit of Concentration: ug/m3

#	CASS #	AQS #	Pollutants	N	SAAC, hourly µg/m3	Maximum, µg/m3	SAAC, annual µg/m3	Average, µg/m3	STD, µg/m3
1	7440473		Hexavalent Chrome Non-corrected	98	2.5	6.727E-04	0.1	1.394E-04	1.020E-04
2	7440473		Hexavalent Chrome Corrected	98	2.5	5.575E-04	0.1	2.070E-05	8.491E-05

### Exhibit 3. Analytical results for Hopewell study – Rice Center Site

#### Hopewell Air Monitoring Project \_ VCU Rice center site (02/05/2007 - 9/27/2008)

Volatile Organic Compounds (Method TO-15) - Unit of Concentration: ug/m3

(Compounds with no detectable results are not included)

#	CAS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	115-07-1	43205	Propylene	2		0.894		0.791	0.146
2	75-71-8	43823	Freon-12	91		3.556		2.525	0.534
3	74-87-3	43801	Methyl Chloride	92	5175	1.712	206	1.178	0.279
9	107-02-8	43505	Acrolein	26	17.25	2.428	0.46	0.684	0.424
10	75-69-4	43811	Freon-11	86		2.245		1.559	0.275
12	75-09-2	43802	Methylene Chloride	45	8700	1.734	348	0.533	0.263
13	76-13-1	43207	Freon-113	70		1.914		0.843	0.219
18	100-54-3	43231	Hexane	5		0.528		0.451	0.068
24	71-43-2	45201	Benzene	50	1600	0.798	64	0.472	0.153
25	56-23-5	43804	Carbon Tetrachloride	72	1550	4.022	62	0.737	0.466
26	110-87-7	43248	Cyclohexane	1		0.378		0.378	
35	108-88-3	45202	Toluene	66	14125	1.317	754	0.549	0.211
41	108-38-3	45109	m&p-Xylene	6	16275	0.564	868	0.492	0.071
43	100-42-5	45220	Styrene	2	10650	0.596	426	0.468	0.181
50	106-46-7	45807	1,4-Dichlorobenzene	1	16525	0.601	902	0.601	

\*Maximum number of samples is 101

#### Hopewell Air Monitoring Project \_ VCU Rice center site (02/05/2007 - 9/27/2008)

Carbonyl Compounds (Method TO-11) - Unit of Concentration: ug/m3

#	CAS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	75070		Acetaldehyde	95	6750	2.75	360	1.41	0.43
2	67641		Acetone	88		10.07		4.42	1.72
3	50000		Formaldehyde	95	62.5	10.69	2.4	3.62	2.23
4	79933		Methyl Ethyl Ketone	70		1.03		0.62	0.17
5	123386		Propionaldehyde	26	NA	2.55	NA	1.12	0.73

\*Maximum number of samples is 101

**Hopewell Air Monitoring Project \_ VCU Rice center site (02/05/2007 - 9/27/2008)**

Metals Scan (PM10 ICPMS Method) - Unit of Concentration: ug/m3

#	CASS #	AQS #	Pollutants	N*	SAAC, hourly µg/m3	Maximum,	SAAC, annual µg/m3	Average, µg/m3	STD
1	7440417		Beryllium	92	0.1	2.838E-04	0.004	6.179E-05	1.375E-04
2	7440473		Chromium	92	2.5	4.104E-03	0.1	2.570E-03	5.805E-04
3	7439965		Manganese	92	250	1.016E-02	10	2.906E-03	1.762E-03
4	7440020		Nickel	92	50	3.374E-03	2	1.091E-03	5.182E-04
5	7440382		Arsenic	92	10	2.554E-03	0.4	8.013E-04	3.988E-04
6	7440439		Cadmium	92	2.5	4.537E-04	0.1	1.439E-04	1.054E-04
7	7439921		Lead	92	7.5	6.170E-03	0.3	2.575E-03	1.211E-03

\*Maximum number of samples is 101

**Hopewell Air Monitoring Project \_ VCU Rice center site (02/05/2007 - 9/27/2008)**

Hexavalent Chrome (Low Flow PM10) - Unit of Concentration: ug/m3

#	CASS #	AQS #	Pollutants	N	SAAC, hourly µg/m3	Maximum	SAAC, annual µg/m3	Average	STD
1	7440473		Hexavalent Chrome Non-corrected	97	2.5	4.73E-04	0.1	1.77E-04	1.03E-04
2	7440473		Hexavalent Chrome Corrected	97	2.5	3.00E-04	0.1	4.33E-05	8.32E-05



#### Exhibit 4. Analytical results for Acrolein using Non-detectable Data

##### **Acrolein data for all 3 sites using 1/1/2008 – 9/30/2008 data**

Comparing data to the urban air toxics sites in Virginia (annual SAAC = 0.46 µg/m<sup>3</sup>)

Value assigned to non-detected sample (µg/m <sup>3</sup> )	Hopewell			UATM		
	Woodson	Spruance	Rice	Lee	MSIC	TRO
None	0.721	0.654	0.684	0.368	0.576	0.388
<MDL = 0	0.455	0.455	0.386	0.344	0.526	0.380
< MDL = 1/2 MDL	0.468	0.465	0.402	0.345	0.528	0.380
<MDL = MDL	0.481	0.476	0.417	0.346	0.531	0.381

##### **Acrolein data using 1/1/2008 – 9/30/2008 data for Woodson and Rice Center**

1/1/2008 – 12/31/2008 data for Spruance (annual SAAC = 0.46 µg/m<sup>3</sup>)

Value assigned to non-detected sample (µg/m <sup>3</sup> )	Hopewell			UATM		
	Woodson	Spruance	Rice	Lee	MSIC	TRO
None	0.721	0.581	0.684	0.368	0.576	0.388
Zero	0.455	0.428	0.386	0.344	0.526	0.380
1/2 MDL	0.468	0.438	0.402	0.345	0.528	0.380
MDL	0.481	0.447	0.417	0.346	0.531	0.381

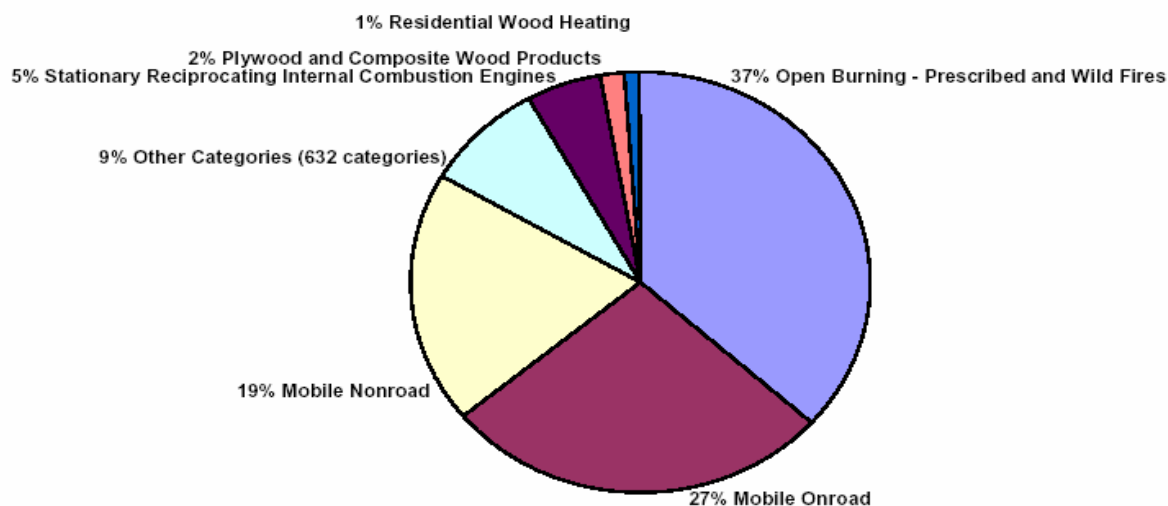
##### **Acrolein data using 1/1/2008 – 9/30/2008 data for Rice Center (annual SAAC = 0.46 µg/m<sup>3</sup>)**

1/1/2008 – 12/31/2008 data for Spruance

1/1/2008 – 12/31/2008 data for Woodson (received 2/5/2009)

Value assigned to non-detected sample (µg/m <sup>3</sup> )	Hopewell			UATM		
	Woodson	Spruance	Rice	Lee	MSIC	TRO
None	0.649	0.581	0.684	0.368	0.576	0.388
Zero	0.436	0.428	0.386	0.344	0.526	0.380
1/2 MDL	0.447	0.438	0.402	0.345	0.528	0.380
MDL	0.459	0.447	0.417	0.346	0.531	0.381

## Formaldehyde Emissions 1999



## Acrolein Emissions 1999

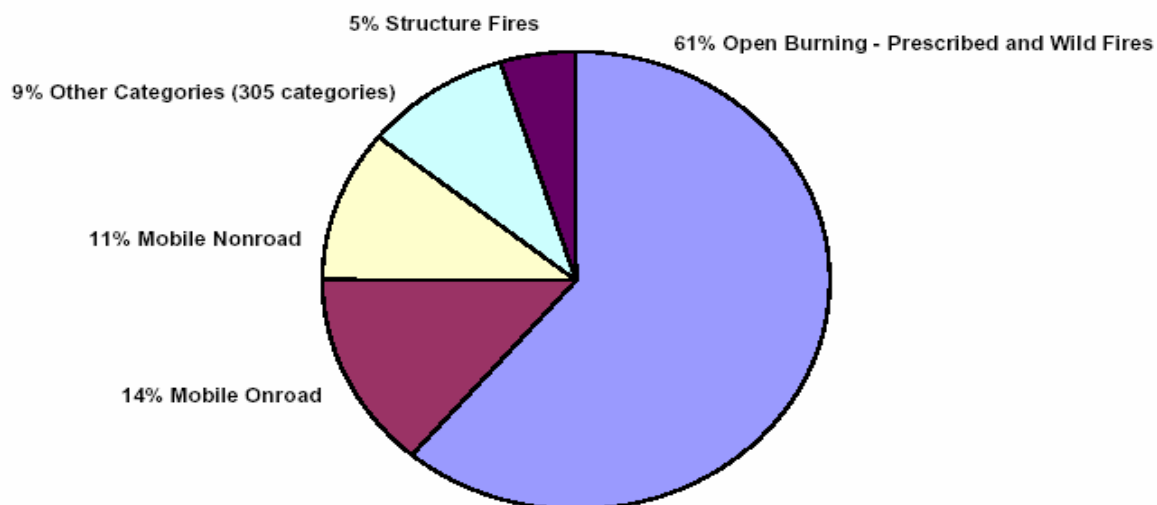
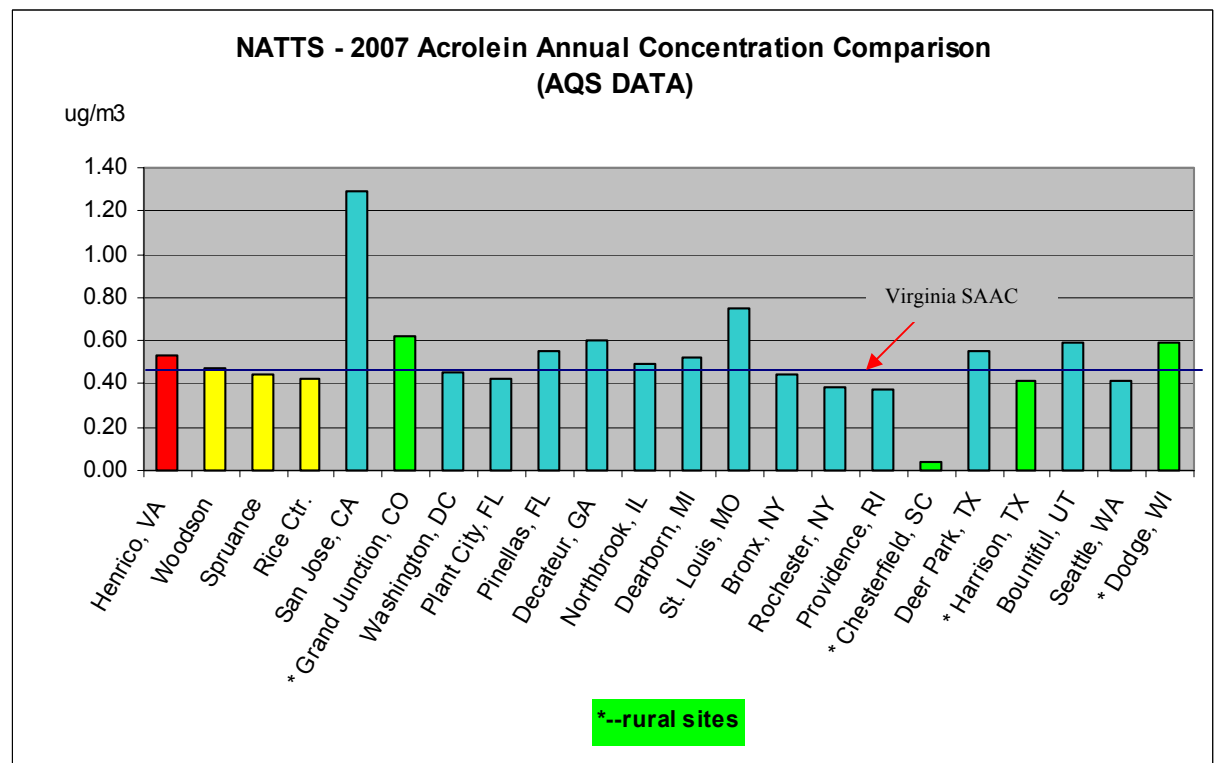
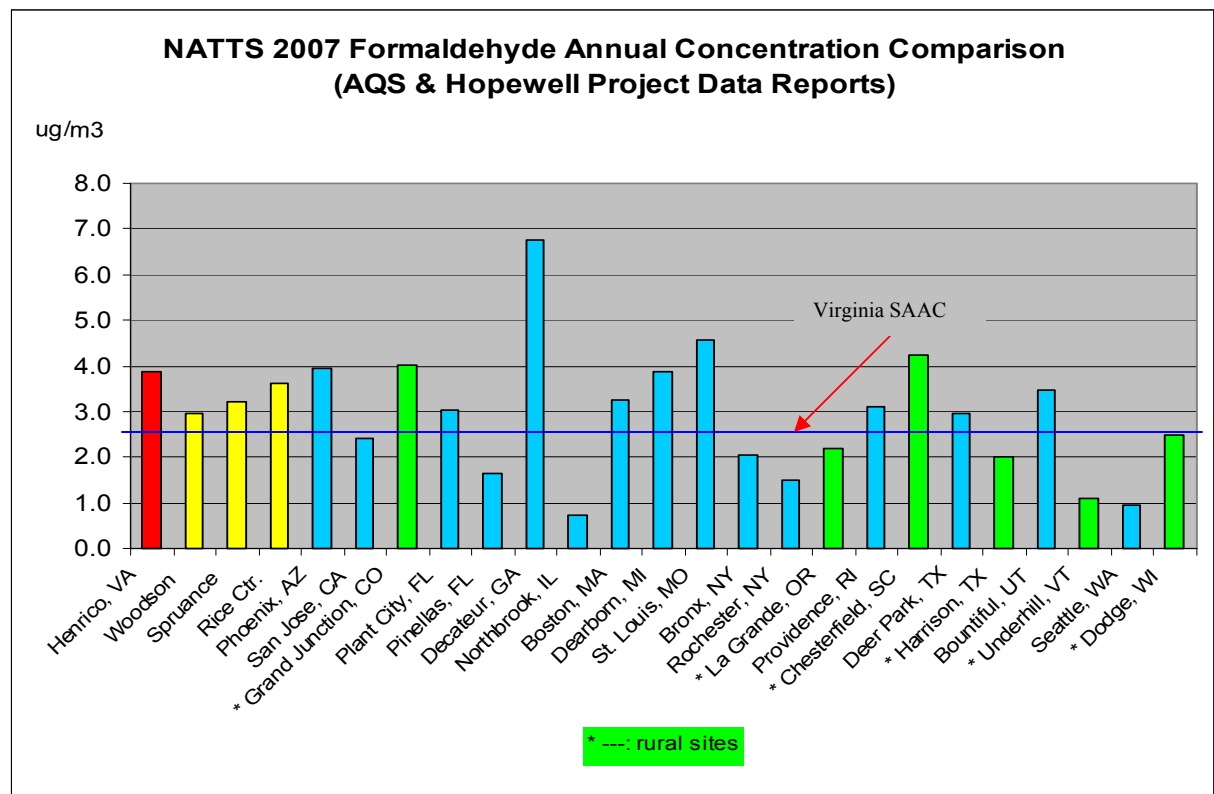


Exhibit 6. National Formaldehyde and Acrolein Data



Hopewell Acrolein data presented in the above chart is for 2008. The data has been adjusted ½ MDL to be consistent with data from the other sites.